MODULAR THERMAL SOLUTION FOR HIGH-PERFORMANCE PROCESSORS

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] This invention relates generally to semiconductor processing, and more particularly to thermal management systems for computing devices and methods of using the same.

[0003] 2. Description of the Related Art

[0004] Heat buildup within computing devices, such as computers and game consoles, is potentially troublesome not only for the high-power dissipation devices, such as the various processors and memory devices within such devices, but also for all of the other components housed within the device enclosure, including data storage devices, chipsets and even the various passive components on a typical system board. To transfer heat from various internal components, many conventional computing devices incorporate a heat sink in thermal contact with the higher heat dissipating devices along with a cooling fan.

[0005] Conventional heat sinks and cooling fans come in a large variety of configurations. Most include multiple thin plates joined or otherwise fastened to a base and spaced closely together. The base is designed to seat on a thermal spreader or lid associated with a given semiconductor device and provide a thermal resistance pathway. In some conventional designs, air is directed past the plates in a direction parallel to the long axes thereof and either allowed to directly exit the plates or first impinge the base and then exit laterally. These parallel flow conventional designs use so-called direct flow. In another variant, air is pulled upward as opposed to being directed downward.

[0006] Many current vendors offer different models of heat sinks Some examples include the Model TR2-R1 CPU Cooler from Thermaltake, the Model CNPS 7500 from Zalman, and the Model SP420B8 CopperStream from Spire.

[0007] Current thermal solutions are designed based on a specific type of chassis conditions such as the available airflow, ambient temperature, and mechanical placement requirements, i.e., keep-outs inside the device case or enclosure. Thus, a given thermal solution has to be designed based on given constraints dictated by the system design. Fans provide airflow that is unique depending on the way a fan is mounted. For example, airflow for a fan positioned on top of a finned heat sink will be different than for one that is side-mounted relative to the heat sink. Furthermore, since conventional heat sinks are tailored to particular system designs, upgrades or other changes to the internals of a device case may require insertion of a completely different style of heat sink and fan arrangement.

[0008] The present invention is directed to overcoming or reducing the effects of one or more of the foregoing disadvantages.

SUMMARY OF EMBODIMENTS OF THE INVENTION

[0009] In accordance with one aspect of an embodiment of the present invention, a thermal management system is provided that includes a heat sink operable to convey heat from a heat generating component and a shroud that has a first opening to direct air in a first direction past the heat sink and a second opening to direct air in a second direction past the heat sink.

[0010] In accordance with another aspect of an embodiment of the present invention, a computing device is provided that includes an enclosure, a heat generating component in the enclosure and a heat sink in the enclosure that is operable to convey heat from a heat generating component. A shroud is in the enclosure and has a first opening to direct air in a first direction past the heat sink and a second opening to direct air in a second direction past the heat sink.

[0011] In accordance with another aspect of an embodiment of the present invention, a method of providing thermal management for a heat generating component is provided. The method includes placing a heat sink in thermal contact with the heat generating component and coupling a shroud to the heat sink. The shroud has a first opening to direct air in a first direction past the heat sink and a second opening to direct air in a second direction past the heat sink. Air is moved through the first opening or the second opening.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The foregoing and other advantages of the invention will become apparent upon reading the following detailed description and upon reference to the drawings in which:

[0013] FIG. **1** is an exploded pictorial view of an exemplary embodiment of a cooling system for a computing device;

[0014] FIG. **2** is a pictorial view of the exemplary cooling system of FIG. **1** depicted unexploded;

[0015] FIG. **3** is a pictorial view like FIG. **2**, but depicting an alternate exemplary air mover placement for the cooling system;

[0016] FIG. **4** is a pictorial view of an alternative exemplary air mover and cooling system shroud;

[0017] FIG. **5** is a pictorial view of an alternative exemplary embodiment of a heat sink; and

[0018] FIG. **6** is a partially exploded pictorial view of an alternate exemplary cooling system for a computing device.

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

[0019] A modular thermal management system for a computing device may include a heat sink, a shroud to selectively route air past the heat sink and an air mover. The heat sink may be placed in thermal contact with a heat generating component of the computing device. The shroud includes two or more openings to route air. The air mover may be selectively mounted to move air through the first opening or the second opening. The different mounting options enable the user to accommodate different internal arrangements of computing device enclosures with a common heat sink and air mover configuration. Additional details will now be described.

[0020] In the drawings described below, reference numerals are generally repeated where identical elements appear in more than one figure. Turning now to the drawings, and in particular to FIG. **1**, therein is depicted a schematic view of an exemplary embodiment of a computing device **10** that includes some form of enclosure **15** depicted as a dashed box. The computing device **10** may include a system board **20**, which may be a printed circuit board or other type of